Yu Deng

Professor of Mathematics
University of Chicago

Contact Information

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Research Interests

Nonlinear dispersive and wave equations, fluid dynamics, harmonic analysis; probabilistic theory for PDEs, statistical physics.

Employment

University of Chicago

- Professor, 2025.6 –
- Associate Professor, 2024.9 – 2025.6

University of Southern California

- Professor, 2024.4 – 2024.7
- Assistant Professor, 2018 – 2024.4

Courant Institute of Mathematical Sciences

- Courant Instructor, 2015 – 2018

Education

Princeton University

- Ph.D. in Mathematics, June 2015. (Advisor: Alexandru Ionescu)
- Dissertation: Long time behavior of some nonlinear dispersive equations

Massachusetts Institute of Technology

- B.S. in Mathematics, June 2011.

Peking University

- Attended Sep 2007 to June 2009.

Honors and Awards

- Clay Research Award (2026)
- ICM Invited Speaker (2026)
- AMS Leonard Eisenbud Prize for Mathematics and Physics (2026)
- Antonio Ambrosetti Medal (2025)
- Oberwolfach Prize (2025)
- ICCM Gold Medal of Mathematics (2025)
- ICCM Best Paper Award (2025)
- Outstanding Young Talent Award, ICBS 2025 (China Annual Review of Mathematics) (2025)
- MCA Prize (2025)
- ICBS Frontiers of Science Award in Mathematics (2024)
- Sloan Research Fellowship (2021)
- Porter Ogden Jacobus Fellowship (2015)
- William Lowell Putnam Fellow (2010)
- International Mathematical Olympiad Gold Medal (2006)

Grant Support

- 2023 – 2026: NSF Grant DMS-2246908 / DMS-2531437
- 2023 – 2026: Research Scientist, Simons Collaboration on Wave Turbulence
- 2019 – 2023: NSF Grant DMS-1900251

Publications

Published and accepted papers

1. Y. Deng, Z. Hani and X. Ma. Long time derivation of Boltzmann equation from hard sphere dynamics. **Ann. of Math.**, to appear.
2. Y. Deng and Z. Hani. Derivation of the wave kinetic equation: full range of scaling laws. **Mem. Amer. Math. Soc.**, to appear.
3. Y. Deng, A. Ionescu and F. Pusateri. On the wave turbulence theory of 2D gravity waves, I: deterministic energy estimates. **Comm. Pure Appl. Math.** 78 (2025), no. 2, 211–322.
4. Y. Deng, A. Nahmod and H. Yue. Invariant Gibbs measures and global strong solutions for nonlinear Schrödinger equations in dimension two. **Ann. of Math. (2)** 200 (2024), no. 2, 399–486.
5. B. Bringmann, Y. Deng, A. Nahmod and H. Yue. Invariant Gibbs measures for the three dimensional cubic nonlinear wave equation. **Invent. Math.** 236 (2024), 1133–1411.
6. Y. Deng and Z. Hani. Propagation of chaos and the higher order statistics in the wave kinetic theory. **J. Eur. Math. Soc. (JEMS)** 28 (2026), no. 2, 673–733.
7. Y. Deng and Z. Hani. Full derivation of the wave kinetic equation. **Invent. Math.** 233 (2023), no. 2, 543–724.

8. Y. Deng and N. Masmoudi. Long time instability of the Couette flow in low Gevrey spaces. **Comm. Pure Appl. Math.** 76 (2023), no. 10, 2804–2887.

9. Y. Deng, A. Nahmod and H. Yue. Random tensors, propagation of randomness, and nonlinear dispersive equations. **Invent. Math.** 228 (2022), no. 2, 539–686.

10. Y. Deng, P. Germain, L. Guth and S. Myerson. Strichartz estimates for the Schrödinger equation on non-rectangular two-dimensional tori. **Amer. J. Math.** 144 (2022), no. 3, 701–745.

11. Y. Deng and Z. Hani. On the derivation of the wave kinetic equation for NLS. **Forum of Math. Pi** 9 (2021), e6, 1–37.

12. Y. Deng, A. Nahmod and H. Yue. Invariant Gibbs measure and global strong solutions for the Hartree NLS equation in dimension three. **J. Math. Phys.** 62 (2021), 031514.

13. Y. Deng, A. Nahmod and H. Yue. Optimal local well-posedness for the periodic derivative nonlinear Schrödinger equation. **Comm. Math. Phys.** 384 (2021), no. 2, 1061–1107.

14. Y. Deng and C. Zillinger. Echo chains as a linear mechanism: norm inflation, modified exponents and asymptotics. **Arch. Rat. Mech. Anal.** 242 (2021), no. 1, 643–700.

15. Y. Deng and C. Zillinger. On the smallness condition in linear inviscid damping: monotonicity and resonance chains. **Nonlinearity** 33 (2020), no. 11, 6176–6194.

16. Y. Deng and F. Pusateri. On the global behavior of weak null quasilinear wave equations. **Comm. Pure Appl. Math.** 73 (2020), no. 5, 1035–1099.

17. Y. Deng. On growth of Sobolev norms for energy critical NLS on irrational tori: Small energy case. **Comm. Pure Appl. Math.** 72 (2019), no. 4, 801–834.

18. Y. Deng and P. Germain. Growth of solutions to NLS on irrational tori. **Int. Math. Res. Not. IMRN** 2019, no. 9, 2919–2950.

19. Y. Deng. Multispeed Klein-Gordon systems in dimension three. **Int. Math. Res. Not. IMRN** 2018, no. 19, 6070–6144.

20. Y. Deng, P. Germain and L. Guth. Strichartz estimates for the Schrödinger equation on irrational tori. **J. Funct. Anal.** 273 (2017), no. 9, 2846–2869.

21. Y. Deng, A. Ionescu, B. Pausader and F. Pusateri. Global solutions of the gravity-capillary water wave system in three dimensions. **Acta Math.** 219 (2017), no. 2, 213–402.

22. Y. Deng, A. Ionescu and B. Pausader. The Euler-Maxwell system for electrons: global solutions in 2D. **Arch. Ration. Mech. Anal.** 225 (2017), no. 2, 771–871.

23. Y. Deng, N. Tzvetkov and N. Visciglia. Invariant Measures and Long Time Behaviour for the Benjamin-Ono Equation III. **Comm. Math. Phys.** 339 (2015), no. 3, 815–857.

24. Y. Deng. Invariance of the Gibbs measure for the Benjamin-Ono equation. **J. Eur. Math. Soc. (JEMS)** 17 (2015), no. 5, 1107–1198.

25. Y. Deng. Two dimensional nonlinear Schrödinger equation with random radial data. **Anal. PDE** 5 (2012), no. 5, 913–960.

Preprints

1. Y. Deng, A. Ionescu and F. Pusateri. On the wave turbulence theory of 2D gravity waves, II: propagation of randomness. **arXiv:**2504.14304.

2. Y. Deng, Z. Hani and X. Ma. Hilbert's sixth problem: derivation of fluid equations via Boltzmann's kinetic theory. **arXiv**:2503.01800.

3. Y. Deng and Z. Hani. Long time justification of wave turbulence theory. **arXiv**:2311.10082.

Expository articles

1. Y. Deng, A. Nahmod and H. Yue. The probabilistic scaling paradigm.
   Vietnam J. of Math. 52 (2024), no. 4, 1001–1015.

2. Y. Deng and Z. Hani. Rigorous justification of the wave kinetic theory. **arXiv**:2207.08358.

Recent Talks

Lecture series and mini-courses

1. *Hilbert's sixth problem: particles and waves.*
   Long-time derivation of kinetic equations from microscopic particle and wave systems (I–III).
   Lessons Jacques-Louis Lions 2025, Jacques-Louis Lions Laboratory, 2025.5.

2. *Hilbert's sixth problem: derivation of the Boltzmann and fluid equations.*
   Riviere Fabes Symposium, University of Minnesota, 2025.4.

3. *Probabilistic well-posedness for nonlinear Schrödinger equation.* ICERM, Brown University, 2021.10.

4. *Long Time Derivation of Boltzmann's Equation (I–II).* Laurent Schwartz Seminar, IHES, 2025.5.

5. *Hilbert's sixth problem: derivation of the Boltzmann and fluid equations (I and II).*
   Simons Center for Geometry and Physics, 2025.4.

6. *Long time derivation of Boltzmann equation from hard sphere dynamics.*
   Chinese Academy of Sciences, 2024.12.

7. *Recent advances in random data problems in nonlinear dispersive equations.*
   Chinese Academy of Sciences, 2023.7.

8. *The mathematical theory of wave turbulence.* University of Helsinki, 2022.11.

9. *Mathematical theory of wave turbulence.* Peking University, 2022.7.

Talks at conferences

1. *Hilbert's Sixth Problem: Particles and Waves.* Distinguished Lecture, ICCM 2025, Shanghai 2026.1.

2. *Recent developments on random data theory for dispersive PDEs.*
   Recent Trends in Stochastic Partial Differential Equations, SLMath 2025.11.

3. *Long time derivation of Boltzmann equation from hard sphere dynamics.*
   Conference on PDEs for Charged Particle Systems, INdAM, Rome 2025.10.

4. *The Hilbert sixth problem: particle and waves.*
   Annual Review of Mathematics in China, Tsinghua University, 2025.8.

5. *Hilbert's sixth problem: particles and waves.*
   International Conference on Probability Aspects of Mathematics, Xiangtan University, 2025.8.

6. *The Hilbert sixth problem: particle and waves.*
   Science China: Mathematics Forum, Zhangye, China 2025.7.

7. *Hilbert's sixth problem: particles and waves.*
   MCA Prize Talk, Mathematical Congress of the Americas, 2025.7.

8. *Recent progress on mathematical wave turbulence.*
   Nonlinear Dispersive Equations: Advances and Perspectives, CIRM Luminy, 2025.5.

9. *Hilbert's Sixth Problem: Derivation of the Boltzmann and fluid equations.*
Workshop on Kinetic Theory and Fluids, University of Wisconsin-Madison, 2025.3.

10. *Hilbert's sixth problem: particles and waves.*
Simons Collaboration on Wave Turbulence Annual Meeting, 2024.12.

11. *Long time derivation of wave kinetic equation.*
Physics of Wave Turbulence and beyond, Les Houches, France, 2024.9.

12. *Recent progress on mathematical wave turbulence.*
Bernoulli-IMS 11th World Congress in Probability and Statistics, Bochum, Germany, 2024.8.

13. *Recent progress on mathematical wave turbulence.*
Workshop on Harmonic and Stochastic Analysis of Dispersive PDEs, Bielefeld, Germany, 2024.6.

14. *Recent progress on probabilistic theory of PDEs.*
Special Session on dynamics and regularity of PDEs, Joint Mathematics Meetings, 2024.1.

15. *Long time justification of wave kinetic theory.*
Simons Collaboration Workshop on Wave Turbulence, New York, 2023.11.

16. *Gibbs measure dynamics in nonlinear dispersive equations.*
International Conference on Probability and Stochastic Analysis, Beijing, 2023.10.

17. *Invariant Gibbs measures in quantum field theory and PDEs.*
Conference on Stochastic Processes and their Applications, Lisbon, 2023.7.

18. *Mathematical theory of wave turbulence.* Workshop on multiscale methods and analysis for dispersive PDEs and applications to quantum materials, Singapore, 2023.2.

19. *Mathematical wave turbulence theory: the full range of scaling laws.*
Simons Summer School: Wave Turbulence and Beyond, Torino, 2022.7.

20. *Invariant Gibbs measures for the three-dimensional cubic nonlinear wave equation.*
Workshop on deterministic dynamics and randomness in PDE, Oberwolfach Institute, 2022.5.

21. *Mathematical wave turbulence and propagation of chaos.*
Frontiers in the Interplay between Probability and Kinetic Theory, ICMS, Edinburgh, 2022.4.

22. *Mathematical wave turbulence and propagation of chaos.*
Shanks Workshop on Mathematical Aspects of Fluids, Vanderbilt University, 2022.2.

23. *Randomness in nonlinear dispersive equation.*
Mathematics Department Colloquium, University of Michigan, 2021.11.

24. *Mathematical wave turbulence and propagation of chaos.* Workshop on Generic Behavior of Dispersive Solutions and Wave Turbulence, ICERM, Brown University, 2021.10.

25. *Full derivation of the wave kinetic equation.*
International Conference for Chinese Young Probability Scholars, 2021.10.

26. *Full derivation of the wave kinetic equation for NLS.* Workshop on new mechanisms for regularity, singularity, and long time dynamics in fluid equations, Banff International Research Station, 2021.7.

27. *Full derivation of the wave kinetic equation for NLS.* Special Session on deterministic and probabilistic aspects of nonlinear evolution equations, Mathematical Congress of the Americas, 2021.7.

28. *On derivation of the wave kinetic equation.*
Mathematics Department Colloquium, Peking University, 2021.4.

Talks at institutes

1. *Long time derivation of Boltzmann equation from hard sphere dynamics.*
   Mathematics Colloquium, University of Toronto and Fields Institute, 2026.3.
2. *Hilbert's Sixth Problem: Particles and Waves.*
   Probability and Stochastic Analysis Seminar EPFL, 2025.10.
3. *The Hilbert sixth problem: particle and waves.*
   Brandeis–Harvard–MIT–Northeastern Joint Mathematics Colloquium, 2025.10.
4. *Hilbert's sixth problem: particles and waves.*
   Frontiers of Mathematics Lecture, The University of Hong Kong, 2025.9.
5. *Gibbs measure dynamics in nonlinear dispersive equations.*
   Calderón-Zygmund Analysis Seminar, University of Chicago, 2025.2.
6. *Long time derivation of Boltzmann equation from hard sphere dynamics.*
   CAMS Colloquium, University of Southern California, 2024.11.
7. *Long time derivation of Boltzmann equation from hard sphere dynamics.*
   Applied Mathematics Colloquium, Brown University, 2024.11.
8. *Long time derivation of Boltzmann equation from hard sphere dynamics.* PDE Seminar, Penn State University, 2024.11.
9. *Recent progress on mathematical wave turbulence.* Analysis Seminar, New York University, 2024.10.
10. *Recent progress on mathematical wave turbulence.*
    Analysis of Fluids Seminar, Princeton University, 2024.10.
11. *Long time derivation of the Boltzmann equation from hard sphere dynamics.*
    Mathematics Department Colloquium, Princeton University, 2024.10.
12. *Long time derivation of Boltzmann equation from hard sphere dynamics.*
    Analysis Seminar, Sorbonne University, France 2024.9.
13. *Long time derivation of Boltzmann equation from hard sphere dynamics.*
    Analysis Seminar, Paris-Saclay University, France 2024.9.
14. *Long time derivation of Boltzmann equation from hard sphere dynamics.*
    Analysis Seminar, ENS Lyon, France 2024.9.
15. *Recent progress on mathematical wave turbulence.*
    Analysis Seminar, California Institute of Technology, 2024.4.
16. *Gibbs measure dynamics in nonlinear dispersive equations.*
    Mathematical Physics Seminar, Princeton University, 2024.3.
17. *Gibbs measure dynamics in nonlinear dispersive equations.*
    PDE/Analysis Seminar, Massachusetts Institute of Technology, 2024.3.
18. *Recent progress on mathematical wave turbulence.* Analysis Seminar, University of Rochester, 2024.3.
19. *Hlbert's Sixth Problem: From Particles to Waves.*
    Mathematics Department Colloquium, University of Rochester, 2024.3.
20. *Recent progress on mathematical wave turbulence.*
    Calderón-Zygmund Analysis Seminar, University of Chicago, 2023.11.
21. *Hlbert's Sixth Problem: From Particles to Waves.*
    Mathematics Department Colloquium, University of Chicago, 2023.11.

22. *Recent progress on mathematical wave turbulence.*
CAMS Colloquium, University of Southern California, 2023.10.

23. *Recent progress on mathematical wave turbulence.* PDE Seminar, University of Maryland, 2023.9.

24. *Mathematical wave turbulence theory: the full range of scaling laws.*
PDE Seminar, Penn State University, 2023.4.

25. *Invariant Gibbs measures in nonlinear dispersive equations.*
Analysis and PDE Seminar, University of Massachusetts Amherst, 2023.4.

26. *Kinetic wave turbulence theory: full range of scaling laws.*
Hyperbolic & Dispersive PDE Seminar, Rutgers University, 2023.2.

27. *Kinetic wave turbulence theory: full range of scaling laws.*
Analysis Seminar, Princeton University, 2023.2.

28. *Mathematical wave turbulence and propagation of chaos.*
Differential Equations Seminar, University of Michigan, 2021.11.

29. *Mathematical wave turbulence and propagation of chaos.*
Stochastic Webinar, Beijing Institute of Technology and Chinese Academy of Science, 2021.10.

30. *Full derivation of the wave kinetic equation for NLS.*
Simons Collaboration on Wave Turbulence Seminar, 2021.7.

31. *Full derivation of the wave kinetic equation (lecture series).*
PDE Seminar, Chinese Academy of Science, 2021.5.

32. *Full derivation of the wave kinetic equation.* Analysis Seminar, Beihang University, 2021.5.

Students and postdocs

Graduate students

- Xilu Zhu (University of Southern California 2019–2025)

Mentored postdocs

- Haitian Yue (University of Southern California 2018–2021)
- Christian Zillinger (University of Southern California 2018–2021)
- Qingtang Su (University of Southern California 2019–2022)
- Katja Vassilev (University of Chicago 2025–)

Services

Editorial boards

- Kinetic and Related Models
- Communications in Analysis and Geometry
- Analysis and PDE

NSF panel service

- Division of Mathematical Sciences (2021)

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